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A novel deep-UV polymer for nanophotonics: waveguides structures towards cascade of serial micro-resonators for ultra-sensitive detections of glucose

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An overview of targeted current research on integrated photonics based on the new deep-UV210 organic material is given [1-6]. We report on the interest in this new material and properties coupled to deep-ultraviolet (DUV) lithography processes towards the realization and optical characterization of sundry photonics structures which can be shaped into ridge or photoinscripted configurations. Such structures include sub-wavelength waveguides, pedestal and tapers waveguides until serial of optical micro-resonators shaped as disk, ring, stadium and racetrack for sensors devoted to glucose detection. The overall design, fabrication and optical characterization of single and multiple resonant micro-structures patterned on the UV210 polymer and shaped by adequate deep-UV lithography procedures will be presented. Various families of ring and racetrack forms are investigated with different geometrical dimensions linked to the micro-resonators and the specific taper-waveguides and gaps allowing the optimized coupling. Well defined photonic structures families in the sub-micrometer range obtained by this deep UV-light process are clearly confirmed through scanning electron microscopy. In order to evaluate and quantify the efficiency of the sub-micrometer coupling, the recirculation of the light and the quality of the optical resonance aspects, a global study including top view intensity imaging, spectral measurements and Fast Fourier Transform analysis is performed for all these devices based on single and multiple family resonators. The experimental TE-mode resonance transmissions reveal a complete agreement with the period of the theoretically expected resonances. Moreover, the large thermo-optic coefficient and the detection principle based on the interaction of the evanescent field with different glucose concentrations demonstrate that this sensor displays high sensitivity on detection properties. Glucose homogeneous sensing capability will be also presented. Different concentrations of glucose solutions result in a red shift of the resonant wavelengths with a linear sensitivity close to 280 pm/(mg/ml).

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Presentation (Invited Oral Talk 20-25 minutes)